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(71) Applicant: Exxon Research and Engineering Company  
P.O.Box 390 180 Park Avenue  
Florham Park New Jersey 07932(US)

(72) Inventor: Jevanoff, Andre  
8 Avenue Wolffers  
B-1310 La Hulpe(BE)

(72) Inventor: Kresge, Edward Nathan  
68 Parlin Lane  
Watchung New Jersey(US)

(74) Representative: Dew, Melvyn John et al,  
Esso Chemical Ltd. Esso Chemical Research Centre P.O.  
Box 1  
Abingdon Oxfordshire, OX13 6BB(GB)

(54) Bituminous compositions.

(57) Bitumen modified with a modifier comprising a defined elastomeric component and a polyolefin component containing polyethylene and polypropylene has improved high temperatures and low temperature properties which make it especially suitable for roofing applications. The elastomeric component is an ethylene propylene copolymer having a broad compositional distribution with regard to its ethylene content.

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Bitumenous Compositions

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This invention relates to bitumenous compositions having improved high temperature and low temperature properties, particularly but not exclusively such compositions which may be used in roofing applications.

10

Bitumen is frequently used in roof coverings, often in the form of layers of fabric which are impregnated with a soft bitumen and coated with a harder bitumen which may be a blown bitumen containing mineral fillers.

15

However, these materials suffer from the problem that they cannot withstand prolonged outdoor exposure because temperature variations can lead to cracks in the harder bitumen layers and to non-recoverable deformations due to creep or flow of the viscous materials. To overcome this several layers for example five layers of bitumenous roof covering are often used, but this inevitably leads to high laying and maintenance costs.

20

Attempts have been made to produce bitumenous felts and suggestions have been made to improve the properties of the felts by modifying the bitumen with certain polymers.

25

As yet however it has not been possible to obtain bitumenous compositions which are completely satisfactory and readily produced, and which form commercially acceptable roofing materials having the desired properties. Ideally the modifier for the bitumen should

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1 be easily incorporated therein from particulate form to  
yield a homogenous composition which remains homogenous  
on storage, and should have a viscosity which permits  
use in normal roofing material manufacturing equipment.  
5 Thus, it is desirable that the roofing material obtained  
should have substantially no creep below 100°C, should  
have adequate flexibility at low temperatures, for  
example, down to -10°C and as low a permanent set as  
possible after 25% elongation. In addition these  
10 properties should preferably be retained after 6 months  
at 70°C, or 1 month at 80°C. In addition to thermal  
stability it is desirable that the material should  
stand up well to UV radiation in accordance with  
the xenon test. This particular feature is however not of  
15 great importance since although it is now common in  
certain cases to leave the bitumenous roofing materials  
exposed to sunlight, whereas hitherto it has been  
conventional to coat the materials with slate or  
chippings which would protect the base material from UV  
20 radiation, the base material is of course black and so  
UV attack is in any case only superficial.

It has been proposed to modify the properties of  
bitumen by blending with styrene-butadiene block  
copolymers. Although this generally improves the  
25 properties of the bitumen immediately after blending  
such as its low temperature creep resistance, flexi-  
bility and elastic recovery, it may have an adverse

1 effect on the heat ageing and UV radiation resistance  
properties of roofing materials formed from the blend.  
Furthermore, styrene-butadiene copolymers can only be  
used in conjunction with certain specific bitumens,  
5 otherwise they are subject to a high mixing rejection  
rate, that is, separation out from the bitumen. It is  
also known to include atactic polypropylene to form a  
bitumen blend suitable for use on flat roofing applica-  
tions; however the balance of properties obtained with  
10 such blends are generally not optimal.

It has been proposed in US Patent 3 669 918 (Dow  
Chemical Company) to include ethylene propylene copolymer  
rubbers into bitumen for roofing applications, but with  
no teaching as to the compositional distribution of  
15 such rubbers. We have found however that such rubbers  
may only be incorporated directly into bitumen if they  
have low molecular weight, since higher molecular  
weight polymers are impossible to disperse in the  
bitumen when using normal blending conditions. Moreover,  
20 incorporation of ethylene propylene rubbers alone into  
bitumen has been found to produce compositions having  
softening points below 100°C, whereas it is highly  
desirable for the softening point to be greater than  
100°C or even 120°C.

25 The incorporation into bitumen of ethylene propylene  
rubbers of high ethylene content, which are usually not  
readily usable with the bitumen, has been achieved

1 according to GB 1 427 307 (SIPLAST) by using a poly-  
olefin as a solid dispersion aid. Thus, the rubber and  
polyolefin are blended and granulated, and this granular  
premixture is then mixed at 180 to 250°C with the  
5 bitumen to give the required dispersion. Similarly,  
GB 1 400 145 (Briggs Amasco Limited) discloses  
bitumenous compositions comprising a mixture of bitumen  
with ethylene propylene ethylidene norbornene terpolymer  
and polyethylene in a minor amount compared with the  
10 rubber. However, neither of these documents teaches  
the use of rubbers having a broad compositional distri-  
bution with regard to the ethylene content.

GB 1 519 508 (HULS) discloses the manufacture of  
homogenous thermoplastic compositions in ribbon or  
15 granule form, which comprise blends of defined poly-  
olefin rubber, optionally additionally a polyolefin,  
and bitumen. The rubber may be an ethylene propylene  
rubber which is a sequence polymer, that is a copolymer  
containing ethylene or an alpha-olefin in addition to a  
20 statistical distribution of the monomers in the polymer  
chain in the form of chain sections of varying length  
(sequences). This gives the polymer good raw strength  
(at least 20 kp/cm<sup>2</sup> at 25°C) and hence permits  
manufacture in comminuted form which is advantageous  
25 for the blending process. Again, though, there is no  
teaching to use rubbers of broad compositional distri-  
bution with regard to the ethylene content.

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1 US 4 110 414 (Goodrich) discloses mouldable thermo-  
plastic polymer blends of high tensile strength prepared  
by mixing low density polyethylenes and high molecular  
weight ethylene propylene copolymers under conditions  
5 of heat and shear. The EP copolymer has a methylene  
run index, i.e., a measure of the ratio of methylene  
units in runs of seven or more to the sum of the runs  
of three methylene units plus the runs of two methylene  
units, of 20 or above, but there is no suggestion here  
10 that such blends might be useful for modifying bitumen.

It has now surprisingly been found that bitumen may be  
advantageously modified, particularly but not exclusively  
for roofing applications, by a combination of a poly-  
olefin component and an elastomeric component of  
15 specific characteristics.

According to the present invention there is provided a  
bitumenous composition which comprises bitumen and,  
dispersed therein in an amount sufficient to modify the  
bitumen to improve its low temperature and high tempera-  
20 ture properties, particularly its suitability for  
roofing applications, a modifier comprising a polyolefin  
component containing polyethylene and polypropylene,  
and an elastomeric component characterised in that the  
elastomeric component comprises an ethylene-propylene  
25 copolymer having a broad compositional distribution with regard to  
its ethylene content. Such bitumenous compositions are also termed  
"polymer asphalt blends" (PAB) herein.

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1 According to a further aspect of the invention there is provided the use of a modifier composition as defined above as an additive for bitumen.

By ethylene-propylene copolymers (EPR) having a broad  
5 compositional distribution (BCD) there is meant EPR having individual polymeric chains with respective ethylene contents which are broadly distributed about the average ethylene content of the copolymer. Typically EPRs with broad compositional distribution include  
10 polymeric chains of ethylene content at least 5, preferably at least 10, weight percent absolute greater than the average ethylene content of the copolymer, and polymeric chains of ethylene content at least 5, preferably at least 10, weight percent absolute less  
15 than said average ethylene content. Preferably for the purposes of this invention the ethylene content of the individual polymer chains includes values of from 5 to 25, more preferably 10 to 25, wt% absolute above and 5 to 25, more preferably 10 to 25 wt% absolute  
20 below the ethylene content of all the polymer chains (depending on the average ethylene content). Thus, for a BCD-EPR of ethylene content 40%, individual chains could be extracted which have ethylene contents as low as 15 wt% to as high as 65 wt% for the broadest  
25 compositional distribution.

The term ethylene propylene copolymer (EPR) as used herein means an elastomeric polymer formed from at



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1 least two monomers, one of which must be ethylene and  
one propylene. Thus, it includes EPM rubbers, and also  
unsaturated rubbers where a minor proportion of one or  
more polyenes such as the endomethylenes, 5-ethylidene  
5 norbornene, 5-methylene norbornene and dicyclopentadiene,  
or a non conjugated aliphatic diene such as 1,4-  
hexadiene is included in the polymeric chains, commonly  
termed EPDM rubbers.

The compositional distribution of an EPR is characterised  
10 by the variation in ethylene to propylene ratio among  
the chains and within the chains. For example if all  
the chains have the same composition and the chains  
have that composition from end-to-end then the material  
is said to have a narrow compositional distribution.  
15 If chains, one versus another, vary greatly in composition  
then the compositional distribution is said to be  
broad that is the individual polymer chains do not all  
have the same % content of ethylene monomeric units,  
but together span a range of ethylene contents.

20 The compositional distribution of an EP copolymer may  
be determined for example by using extraction techniques,  
solvent fractionation, or gel permeation chromatography  
to split the copolymer into its various molecular  
weight fractions. The ethylene content of these  
25 fractions is then measured by a standard method such as  
infra-red absorption or nuclear magnetic resonance.  
Thus according to one fractionation technique the

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1 copolymer is dissolved in a solvent such as hexane, and  
aliquots of a precipitant such as an alcohol are  
progressively added. High molecular weight fractions  
are precipitated first, with lower molecular weight  
5 fractions being deposited as the alcohol concentration increases. According to another technique the  
solid copolymer is deposited on glass beads, and then  
progressively eluted therefrom by treatment with  
amounts of progressively more powerful solvent, for  
10 example alcohol/hexane mixtures with increasing hexane  
concentration, or by the same strength solvent at  
increasing temperatures. Here, the low molecular  
weight fractions are eluted first, followed by higher  
molecular weight fractions. It has been found that  
15 with EPRs having a low average ethylene content, e.g.  
approx. 40 wt%, the longer chain (higher molecular  
weight) fractions tend to have a higher ethylene  
content than the shorter chain (lower molecular weight)  
fractions. However this is not necessarily the case  
20 with broad compositional distribution EP copolymers  
with higher average ethylene contents.

The compositional distribution of the copolymer may be  
defined, as above, in terms of the extremes of composition versus the average ethylene content; or  
25 alternatively by determining the entire range of  
composition among the chains.

1 It has been found that modified bitumens in accordance  
with the invention yield much better properties (for  
example low temperature and elastic). Thus at low  
temperatures close to glass transition temperature the  
5 flexibility of the material is increased whilst at high  
temperatures e.g. glass transition temperature + 130  
degrees C, the flow is decreased i.e. softening point  
is increased. By high temperatures as mentioned  
hereinbefore there is meant the sort of temperatures to  
10 which roofing felts incorporating the PAB may be  
routinely subjected in use at various locations through-  
out the world, or to which PABs are subjected during  
testing for suitability for such applications. For  
example these high temperatures may be in the range  
15 70-130°C, particularly 80-120°C and especially 100-120°C.  
It is emphasised here, though, that the PABs according  
to the invention are not limited in their use to  
roofing applications, but may also be used for example  
in pipe-wrapping applications. By low temperatures  
20 as mentioned hereinbefore there is meant the sort of  
temperatures to which for example rolls of roofing felt  
incorporating the PAB may be subjected prior to un-  
rolling such rolls for application to a roof surface at  
various locations worldwide, or to which PABs are  
25 subjected for testing their suitability for such  
applications. For example these low temperatures may  
be in the range 0 to -30°C, particularly -15 to -25°C.

- 1 For roofing applications, such modified bitumens  
compare well with bitumen treated with conventional  
modifying systems such as those wherein the EP copolymers  
have a narrow compositional distribution or wherein the  
5 EPR is not in combination with the polyolefin component.  
It is speculated that this improvement derives from the  
interaction of the broad compositional distribution  
polymer chains with the polyolefin components of the  
modifier system and the bitumen.
- 10 The use of BCD-EPRs in bitumen (asphalt) modifier  
systems according to the invention has been found to be  
particularly advantageous when the copolymer has a low  
average ethylene content, for example less than 50% or  
53% by weight, particularly from 40 to 45 wt%. In  
15 general, the lower the ethylene content of an EPR, the  
lower is its crystallinity. It is known that bitumen  
modified with EPR of high crystallinity (high ethylene  
content) has an improved mechanical strength, but by

1 virtue of this high ethylene content such EP copolymers  
are considerably more difficult to incorporate into the  
bitumen than low ethylene content EPRs. According to  
the invention modifier systems including EP copolymers  
5 of low average ethylene content but broad compositional  
distribution not only give improved properties to the  
bitumenous composition, but also are more readily  
incorporated into the bitumen by the techniques common  
in the art. It is speculated that low ethylene content,  
10 broad compositional distribution EP copolymers have,  
despite their low average ethylene content, an increased  
crystallinity because they include polymeric chain  
segments containing ethylene in a proportion which is  
at least 5 wt% absolute greater than the average.  
15 Thus, certain copolymer chain segments will effectively  
contain blocks of "polyethylene" which interact with  
each other and with the polyethylene in the modified  
bitumen. The lower ethylene content chain segments  
interact with the polypropylene and the bitumen. With  
20 normal narrow compositional distribution EP copolymers  
(NCD-EP) much higher ethylene contents are required

1 to yield such interaction with polyethylene. Moreover  
there are fewer low ethylene chain segments in the high  
ethylene NCD-EP copolymers to interact with the bitumen  
and polypropylene. Of course in accordance with the  
5 invention BCD-EPRs with relatively high ethylene  
contents, e.g., 50 to 70 or even 80% may be used, but  
here the advantages of the BCD are less evident by  
virtue of the inherent high crystallinity of these materials.

According to another aspect of the invention there is  
10 provided a method of producing bitumenous compositions  
as hereinbefore defined which comprises first forming a  
modifier masterbatch of the BCD-EPR and the polyolefin  
component containing polyethylene and polypropylene,  
and subsequently incorporating the masterbatch into the  
15 bitumen.

By way of example the masterbatch may be prepared by  
incorporating all the ingredients in an internal mixer  
e.g. Banbury type, and mixing for about 3 minutes at  
flux temperature e.g. about 140°C. Subsequently the  
20 mixture is pelletised using a single screw extruder,  
and the pellets dusted with talc to prevent agglomeration.  
This method is useful for laboratory scale work. For  
more economical bulk scale work, mixing and pelletisation  
may be performed for example in a high intensity dual  
25 screw continuous mixer, such as a Werner-Pfleiderer or  
a Farrel, with a die temperature of about 180°C.

1 Any form of bitumen may be used provided it is compatible  
with the modifier. For example the bitumen may be  
Safaniya 180/220, which is a non-blown (non-oxidised)  
straight bitumen of moderate aromaticity from Saudi  
5 Arabia.

It has been found that such modifiers may be incorpo-  
rated into the bitumen using conventional blending  
equipment to give a homogeneous blend which is generally  
stable on storage and of a viscosity that may be  
10 processed under normal roofing material manufacturing  
conditions. Thus yet another aspect of the invention  
provides for the use of such bitumenous compositions as  
roofing materials, which are generally found to have  
desirable physical properties which are retained after  
15 heat ageing.

By way of example, the modifier may be incorporated  
into the bitumen under laboratory conditions by heating  
the bitumen to 200-205°C in a rapidly (1000 rpm)  
stirred glass reactor and adding modifier in pellet  
20 form over 15 minutes without vortex formation, stirring  
being continued for about 1 hour after the addition.  
Dispersion quality may be checked visually (film test,  
or preferably using a microscope). Alternatively paddle  
mixing at e.g. 60 rpm for about 4 hour may be employed.  
25 On a bulk scale an industrial paddle mixer at e.g. 20  
rpm may be used, with addition of modifier over e.g. 1

1 hour and further mixing at reduced temperature e.g. 180-  
190°C., optionally with addition of filler, for about 1 hour.

The modifier system is preferably incorporated in the  
bitumen in a proportion of from 5 to 20% by weight  
5 based on the composition as a whole, such a proportion  
having been found to give optimum end product physical  
properties in conjunction with commercial acceptability.  
More preferred is the range 9 to 16 wt% and particularly  
the range 12 to 16 wt%. Such compositions generally  
10 have been found to have good high temperature properties,  
e.g., softening points in excess of 100°C, which is a  
requirement for roofing applications (thought to derive  
in part from the polyethylene content of the polyolefin  
component); and good low temperature properties, e.g.,  
15 brittle failure only at -10°C or below (thought to  
derive in part from the polypropylene content of the  
polyolefin component).

The polyethylene is preferably high density polyethylene  
(HDPE), and the polypropylene is preferably atactic  
20 polypropylene (APP), with the ratio between these two  
in the polyolefin component depending to a great extent  
on the properties required of the bituminous composition.  
For example APP tends to depress softening point but  
improve low temperature characteristics, whereas HDPE  
25 tends to increase the softening point for example to  
120-130°C which is highly desirable for roofing applica-  
tions. However HDPE may be detrimental to elasticity



1 by virtue of its high <sup>-15</sup> crystallinity. From the above it  
may be considered that the APP functions as a plasticizer  
for the rubber, and in this regard it functions even  
for EPRs which do not have a broad compositional  
5 distribution.

As mentioned, the composition of the modifier may vary  
in dependence on the desired end properties. Preferably  
the modifier will comprise from 40 to 60 wt% of the  
elastomeric component, or indeed even greater amounts  
10 of BCD-EPR, for example from 50 to 75%, with the  
balance being polyolefin component. In this polyolefin  
component the ratio of polyethylene to polypropylene is  
preferably in the range 40:60 to 60:40 by weight, more  
preferably in the ratio 1:1. A particularly useful  
15 modifier system contains BCD-EPR:APP:HDPE in the weight  
ratio 50:25:25. The modifiers may also contain additives  
such as stabilizers and antioxidants. Preferably  
reinforcing fillers such as carbon black or silica are  
not used since although they can improve the softening  
20 point of the bitumenous composition, their presence  
tends to increase brittle failure at low temperatures.

The BCD-EPRs which have been found to be useful in  
bitumenous compositions according to the invention  
may be produced by conventional copolymerisation  
25 techniques adapted to yield the BCD product by control  
of process conditions as is well understood in the art.  
For example the degree of agitation in the copoly-

1 merisation reactor can be adjusted to give the desired  
product. Alternatively, of the numerous copolymerisation  
catalyst systems that are known, the various combinations  
of catalyst and cocatalyst can be adjusted by relatively  
5 simple testing methods to yield EPRs having the compositional  
distribution of any sufficient breadth for the proposed end  
use of the bitumenous composition.

The bitumenous compositions of the present invention may  
be processed into roofing materials by standard proces-  
10 sing techniques. They may be used to impregnate felts  
and as intermediate layers in the traditional multilayer  
roofing materials; however they are primarily intended  
for use in the preparation of single or double layer  
roofing materials. In either circumstance it has been  
15 found that the use of the bitumen compositions of the  
present invention permits the fabrication of roofing  
materials of improved viscoelastic properties.  
Softening point, low temperature flexibility and ageing  
characteristics are also generally improved.

20 The following Examples illustrate the invention.

Example 1

A modifier masterbatch was produced by blending together  
a BCD-EPR, APP and HDPE in a ratio by weight of 50:25:25.  
The EPR had an average ethylene content of 42% by  
25 weight, and a broad compositional distribution (as  
hereinbefore defined) by virtue of the catalyst system  
employed in its production. Its density was 0.86 g/cc

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1 (23°C);  $M_L(1+8)$  value 33 at 100°C inherent viscosity  
3.34 (in decalin at 135°C); and molecular weight  
characteristics (by GPC in 1,2,4 trichlorobenzene at  
135°C)  $M_n = 6300$ ,  $M_w = 296,000$ ,  $M_w/M_n = 47$ , broad MWD.  
5 The APP was AMOCO grade 115-601 A of density 0.85 g/cc  
at 23°C, Brookfield viscosity range 200-1200 cps at  
190°C, and ash content 0.05 wt.% max.  
The HDPE was HD 6950 (ESSO), a narrow molecular  
weight distribution product of density 0.963 g/cc  
10 (23°C, ASTM D 1505); and melt index 7 g/10 min (ASTM D  
1238, 2.16 kg load).

Blending was by incorporating all the ingredients in a  
Banbury internal mixer and mixing at flux temperature  
(about 140°C) for 3 minutes. Thereafter the blend was  
15 pelletised in a single screw extruder and the pellets  
dusted with talc to prevent agglomeration.

To yield a bitumenous composition containing 12 wt%  
modifier and 88 wt% bitumen, the modifier was then  
incorporated into a 200 penetration straight bitumen of  
20 Safaniya origin. Thus the bitumen was  
heated to 200-205°C in a rapidly stirred glass reactor  
and masterbatch pellets were added over a 15 minute  
period, without vortex formation (but with dimples  
being observed at the bitumen/air interface). After the  
25 addition mixing was continued for 1 hour.

The composition was tested for its suitability for  
roofing applications by the following methods.

- 1 (a) Softening point: by the "Ring and Ball" method,  
ASTM D-36, expressed in °C.
- (b) Foldability: by a non-standard method, a strip  
of the bitumenous composition (2x30x100m) is  
5 conditioned at a constant temperature for 1  
hour and then folded (over a period of 5  
seconds) around a mandrel of 10mm diameter.

If the sample does not exhibit surface micro-  
cracks, the procedure is repeated at a lower  
10 temperature (reduced by 5 degrees C stepwise)  
until such time that microcracks do appear  
onfolding, the temperature of first cracking  
being considered as the foldability value.

Results of the tests showed a high softening point of  
15 119°C and a low foldability value of -10°C, these being  
excellent values for roofing applications.

#### Example 2

The procedure of Example 1 was repeated but using a  
BCD-EPR of average ethylene content 65 wt%. Test  
20 results gave a softening point of 116°C and a fold-  
ability value of -10°C.

#### Comparison Example 3

Example 1 was repeated, but using an EPR which although  
having an ethylene content of 42%, had a narrow composi-  
25 tional distribution. Test results gave values of 84°C  
and -5°C respectively for softening point and foldability.

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- 1 Such values are not acceptable for roofing applications where the product will be subjected to extremes of hot and cold weather.

Comparison Example 4

- 5 Example 1 was repeated, using an EPR with an ethylene content of 65%. The EPR had the same Mooney viscosity as that of Example 1, but an extremely narrow compositional distribution. Moreover it had a narrow MWD ( $M_w/M_n = 2$ ). The crystallinity of this rubber was
- 10 so high that it was found to be extremely difficult to produce the modifier in the Banbury mixer. Thus a much longer (and hence less economical) mixing time was required to form the modifier blend. Test results gave values of 119°C and -10°C for softening point and
- 15 foldability respectively which of course compares well with Example 1, but for a much higher ethylene content of the rubber, and a much less convenient and uneconomical blending procedure.

1. A bitumenous composition which comprises bitumen and, dispersed therein in an amount sufficient to modify the bitumen to improve its low temperature and high temperature properties, a modifier comprising a polyolefin component containing polyethylene and polypropylene, and an elastomeric component, characterised in that the elastomeric component comprises an ethylene-propylene copolymer having a broad compositional distribution with regard to its ethylene content.
2. A composition according to claim 1, wherein the copolymer includes polymeric chains of ethylene content at least 5 wt% absolute greater than the average ethylene content of the copolymer, and polymeric chains of ethylene content at least 5 wt% absolute less than said average.
3. A composition according to claim 2, wherein the copolymer includes polymeric chains of ethylene content from 5 to 25 wt% absolute greater than the average and from from 5 to 25 wt% absolute less than said average.
4. A composition according to claim 1, 2 or 3, wherein the copolymer has an average ethylene content of less than 53 wt%.

5. A composition according to claim 4, wherein the copolymer has an average ethylene content of from 40 to 45 wt%.
6. A composition according to any one of the preceding claims, wherein the copolymer comprises EPM rubber.
7. A composition according to any one of the preceding claims, wherein the copolymer comprises EPDM rubber.
8. A composition according to any one of the preceding claims, wherein the polyethylene is high density polyethylene and/or the polypropylene is atactic polypropylene.
9. A composition according to any one of the preceding claims, which comprises from 5 to 20 wt% modifier, based on the composition as a whole.
10. A composition according to claim 9, which comprises from 12 to 16 wt% modifier.
11. A composition according to any one of the preceding claims, wherein the modifier comprises from 40 to 60 wt% of elastomeric component, based on the modifier as a whole.
12. A composition according to any one of the preceding claims, wherein the polyolefin component comprises polyethylene and polypropylene in a ratio of from 40:60 to 60:40 by weight.

13. A composition according to claim 1, which comprises from 12 to 16 wt% of a modifier comprising copolymer, atactic polypropylene and polyethylene in a weight ratio of 50:25:25, said copolymer having an average ethylene content of about 40 wt% and containing individual chains with ethylene contents of about 15 to 35 wt% and about 45 to 65 wt%, and from 84 to 88 wt% of a 180/220 penetration bitumen.
14. A method of producing a bitumenous composition according to claim 1, characterised in that the polyethylene, polypropylene and ethylene-propylene copolymer are blended together to form the modifier, and said modifier is then mechanically dispersed as a masterbatch in the bitumen.
15. A bitumenous composition according to any one of claims 1 to 13, or when produced by the method according to claim 14, when in the form of a roofing material.
16. A method of protecting a roof which comprises applying thereto a bitumenous composition according to claim 15.
17. The use as an additive for bitumen of a modifier composition comprising a polyolefin component containing polyethylene and polypropylene, and as elastomeric component, an ethylene-propylene copolymer having a broad compositional distribution with regard to its ethylene content.





European Patent  
Office

# EUROPEAN SEARCH REPORT

0131397

Application number

EP 84 30 4027

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. *)
A	FR-A-2 228 817 (SOCIETE NOUVELLE SIPLAST) * Page 2, lines 12-28; page 7, claims 3,4 * & GB - A - 1 427 307 (Cat. D)		C 08 L 95/00 C 08 L 23/02 // C 08 L 23/16 C 08 L 23/06 C 08 L 23/12
A,D	GB-A-1 400 145 (BRIGGS AMASCO)		
A	US-A-4 368 228 (ROMOLO GORGATI)		
A	DE-A-2 219 147 (PHOENIX GUMMIWERKE)		
A	US-A-3 963 659 (GERHARD BINDER)		TECHNICAL FIELDS SEARCHED (Int. Cl. *)
			C 08 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 05-10-1984	Examiner GIRARD Y.A.
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